

**TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371**

INTERNATIONAL APPLICATION NO.
PCT/GB99/03476INTERNATIONAL FILING DATE
October 20, 1999

ATTORNEY'S DOCKET NUMBER

36290-151370

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

09/830209PRIORITY DATE CLAIMED
October 22, 1998

TITLE OF INVENTION

Method and Apparatus For Spraying

APPLICANT(S) FOR DO/EO/US

Jim Lindsay and George Walter Robsinson

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.
4. The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
 - a. is attached hereto (required only if not communicated by the International Bureau).
 - b. has been communicated by the International Bureau.
 - c. is not required, as the application was filed in the United States Receiving Office (RO/US).
6. An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
 - a. is attached hereto.
 - b. has been previously submitted under 35 U.S.C. 154(d)(4).
7. Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
 - a. are attached hereto (required only if not communicated by the International Bureau).
 - b. have been communicated by the International Bureau.
 - c. have not been made; however, the time limit for making such amendments has NOT expired.
 - d. have not been made and will not be made.
8. An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. A **FIRST** preliminary amendment.
16. A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. A substitute specification.
18. A change of power of attorney and/or address letter.
19. A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. Certificate of Mailing by Express Mail
23. Other items or information:

Express Mail Label No. EL 740326013 US

U.S. APPLICATION NO. (IF KNOWN SEE 37 CFR 097830209	INTERNATIONAL APPLICATION NO. PCT/GB99/03476	ATTORNEY'S DOCKET NUMBER 36290-151370
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24. The following fees are submitted:

CALCULATIONS PTO USE ONLY**BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :**

- | | |
|--|-----------|
| <input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO | \$1000.00 |
| <input checked="" type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO | \$860.00 |
| <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO | \$710.00 |
| <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) | \$690.00 |
| <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) | \$100.00 |

ENTER APPROPRIATE BASIC FEE AMOUNT =

\$860.00

Surcharge of \$130.00 for furnishing the oath or declaration later than
months from the earliest claimed priority date (37 CFR 1.492 (e)). 20 30

\$0.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	32 - 20 =	12	x \$18.00	\$216.00
Independent claims	3 - 3 =	0	x \$80.00	\$0.00

 Multiple Dependent Claims (check if applicable)**TOTAL OF ABOVE CALCULATIONS =**

\$1,076.00

 Applicant claims small entity status. (See 37 CFR 1.27). The fees indicated above are reduced by 1/2.

\$538.00

SUBTOTAL =

\$538.00

Processing fee of \$130.00 for furnishing the English translation later than
months from the earliest claimed priority date (37 CFR 1.492 (f)). 20 30

+ \$0.00

TOTAL NATIONAL FEE =

\$538.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be
accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable).

\$0.00

TOTAL FEES ENCLOSED =

\$538.00

<input type="checkbox"/> <u>Amount to be: refunded</u>	\$
<input type="checkbox"/> charged	\$

- a. A check in the amount of \$538.00 to cover the above fees is enclosed.
- b. Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.
- c. The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 50-0573 A duplicate copy of this sheet is enclosed.
- d. Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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23973

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SIGNATURE

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30,480

REGISTRATION NUMBER

April 20, 2001

DATE

09/830209

JC18 Rec'd PCT/PTO 20 APR 2001

PATENT

Attorney Docket No.: 36290-151370

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Patent application of :
Jim Lindsay and George Walter Robinson. :
Serial No.: Not Yet Assigned : Group Art Unit:
(International Serial No. PCT/GB99/03476) : Not Yet Assigned
Filed: Concurrently Herewith : Examiner:
(International Filing Date: October 20, 1999) : Not Yet Assigned
For: Method and Apparatus For Spraying :
:

PRELIMINARY AMENDMENT

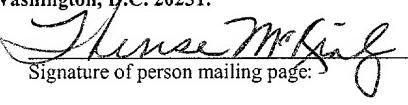
Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Kindly amend the above-identified patent application, without prejudice, as follows.

In the Claims:

Amend claims 3, 4, 6, 7, 11, 15, 16, 17, 18, 19, 22, 23, 24 and 28 as follows. A mark-up of the amended claims as required by 37 C.F.R. 1.211(c)(ii) is attached hereto as Appendix A.

CERTIFICATE OF MAILING UNDER 37 C.F.R. 1.10
EXPRESS MAIL Mailing Label Number: <u>EL 740326013</u> Date of Deposit: <u>April 20, 2001</u>
I hereby certify that this correspondence, along with any paper referred to as being attached or enclosed, and/or fee, is being deposited with the United States Postal Service, "EXPRESS MAIL-POST OFFICE TO ADDRESSEE" service under 37 CFR 1.10, on the date indicated above, and addressed to: Commissioner for Patents, Washington, D.C. 20231.  Signature of person mailing page:
Therese McKinley Type or print name of person

3. (Amended) An apparatus according to Claim 1, wherein said second passageway is substantially conical in shape.

4. (Amended) An apparatus according to Claim 1, wherein said second passageway includes an inlet and an outlet, wherein said second passageway is tapered from said inlet to said outlet.

6. (Amended) An apparatus according to Claim 4, wherein said second passageway has a radius of curvature at said outlet so as to provide gas to the outlet nozzle in a substantially horizontal direction.

7. (Twice Amended) An apparatus according to Claim 1, wherein said stepped portion of said second passageway comprises a ledge whose width tapers up to maximum of 10% of the radius if said second passageway at the level of the stepped portion.

11. (Twice Amended) An apparatus according to Claim 10 any preceding claim, further comprising a trigger means;

whereby said trigger means is adapted to operate both of said control valve and said gas valve.

15. (Twice Amended) An apparatus according to either Claim 13, wherein said piston valve produces an annular air jet in said second passageway.

16. (Twice Amended) An apparatus according to Claim 13, further comprising an air control valve stem which is connected to said piston valve and operated by said trigger means.

17. (Twice Amended) An apparatus according to Claim 13, supplied with a liquid by said gravity liquid reservoir.

18. (Amended) An apparatus according to Claim 12, wherein the liquid control needle valve is controlled by said trigger means via an axially-sliding sleeve or slipper member situated on a rearward portion of said housing.

19. (Amended) An apparatus according to Claim 12, wherein said liquid control needle valve is provided with a rotational flow adjustment means.

22. (Amended) An apparatus according to Claim 12, wherein said liquid inlet comprises a pressurized material supply connector, and wherein said needle valve is supplied with a liquid by said pressurized material supply connector.

23. (Amended) an apparatus according to Claim 12, wherein said liquid inlet comprises a gravity feed liquid reservoir, and wherein said needle valve is supplied with a liquid by said gravity liquid reservoir.

24. (Amended) An apparatus according to Claim 10, further comprising a regulating valve and a pair of side jets, whereby the spray pattern of the outlet nozzle is regulated by said regulating valve, and said side jets are utilised to regulate said spray pattern.

28. (Amended) A method according to Claim 25, wherein the mixing of said liquid and said annular gas jet is controlled by a trigger valve mechanism on said spray apparatus.

REMARKS

Claims 1-34 are pending in the application. The claims have been amended to reduce dependencies to decrease the filing fee.

Respectfully submitted,

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APPENDIX A - “Marked-up” Versions of Amended Claims as Required Under

37 C.F.R. 1.121(c)(1)(ii)

3. (Amended) An apparatus according to [either] Claim 1 [or Claim 2], wherein said second passageway is substantially conical in shape.

4. (Amended) An apparatus according to Claim 1 [any preceding claims], wherein said second passageway includes an inlet and an outlet, wherein said second passageway is tapered from said inlet to said outlet.

6. (Amended) An apparatus according to [either] Claim 4 [or Claim 5], wherein said second passageway has a radius of curvature at said outlet so as to provide gas to the outlet nozzle in a substantially horizontal direction.

7. (Amended) An apparatus according to Claim 1 [any preceding claim], wherein said stepped portion of said second passageway comprises a ledge whose width tapers up to maximum of 10% of the radius if said second passageway at the level of the stepped portion.

11. (Amended) An apparatus according to Claim 10 [any preceding claim], further comprising a trigger means;

whereby said trigger means is adapted to operate both of said control valve and said gas valve.15. (Twice Amended) An apparatus according to either Claim 13 [or Claim 14], wherein said piston valve produces an annular air jet in said second passageway.

16. (Amended) An apparatus according to [any of Claims] Claim 13 [to 15], further comprising an air control valve stem which is connected to said piston valve and operated by said trigger means.

17. (Amended) An apparatus according to [any of Claims] Claim 13 [to 16], supplied with a liquid by said gravity liquid reservoir.

18. (Amended) an apparatus according to [any of Claims] Claim 12 [to 17], wherein the liquid control needle valve is controlled by said trigger means via an axially-sliding sleeve or slipper member situated on a rearward portion of said housing.

19. (Amended) An apparatus according to [any of Claims] Claim 12 [to 18], wherein said liquid control needle valve is provided with a rotational flow adjustment means.

22. (Amended) An apparatus according to [any of Claims] Claim 12 [to 21], wherein said liquid inlet comprises a pressurized material supply connector, and wherein said needle valve is supplied with a liquid by said pressurized material supply connector.

23. (Amended) an apparatus according to [any of Claims] Claim 12 [to 21], wherein said liquid inlet comprises a gravity feed liquid reservoir, and wherein said needle valve is supplied with a liquid by said gravity liquid reservoir.

28. (Amended) A method according to [any of Claims] Claim 25 [to 27], wherein the mixing of said liquid and said annular gas jet is controlled by a trigger valve mechanism on said spray apparatus.

24. (Amended) An apparatus according to Claim 10 [any preceding claim], further comprising a regulating valve and a pair of side jets, whereby the spray pattern of the outlet nozzle is regulated by said regulating valve, and said side jets are utilised to regulate said spray pattern.

09/830209

JC18 Rec'd PCT/PTO 20 APR 2001

WO 00/24521

PCT/GB99/03476

1 METHOD AND APPARATUS FOR SPRAYING

2

3 The present invention relates to a method and apparatus
4 for low air pressure spraying. Particularly, but not
5 exclusively, the invention is applicable to spray guns
6 for the application of paint and like material surface
7 treatments, particularly water-based paints.

8

9 The use of spray guns for application of paints is well
10 known. However, it has been found that when water-
11 based, high gloss paints are sprayed through a high
12 pressure or conventional spray gun, the level of gloss
13 is reduced. This is also true of the high volume-low
14 pressure type of spray gun which operate at only 10psi
15 air cap pressure.

16

17 Tests carried out at various pressures have shown that
18 the loss of gloss is due to air bubbles rising to the
19 surface of the paint as it dries. It has been found
20 that the greater the pressure used to spray the paint,
21 the more air bubbles appear. The cause of the bubbles
22 is that dissolved air is being released from the water
23 as the paint dries. The greater the air pressure when
24 the paint is sprayed, the greater the volume of
25 dissolved air and the greater the number of bubbles.

1 If the air pressure is low but the volume is high,
2 gloss levels are reduced. To achieve the desired gloss
3 levels with this type of paint it is necessary to
4 design a spray gun that will operate at very low air
5 pressures and very low air volumes. It must achieve
6 acceptable levels of atomization, have sufficient
7 energy to transfer the paint at an acceptable rate to
8 the surface of the target, and expand the natural cone
9 of spray into a useful fan pattern.

10

11 In the past, spray guns have used air pressures between
12 40 and 90 psi, and these high pressures cause a cushion
13 of air to be formed on the surface of the product being
14 treated. This cushion causes some of the sprayed
15 material to bounce back and be displaced laterally by
16 the following airflow to be lost in the surrounding
17 air.

18

19 Accordingly, this type of spray gun is very
20 inefficient. Rarely are transfer efficiencies greater
21 than 40% and more often nearer 30%. The waste paint
22 material produces unacceptable emissions of volatile
23 organic compounds and leaves a solid residue which can
24 remain floating in the air for some time. These can be
25 highly toxic and damaging to the atmosphere and health.
26 To overcome these problems, it is necessary to reduce
27 the air pressure and air volume used in such guns.
28 Therefore, the environmental requirements for an
29 acceptable spray gun are similar to those required for
30 achieving a good gloss in water-based paints.

31

32 If the air pressure is reduced on a spray gun that was
33 originally designed for high pressure use, the
34 turbulence and restrictions in internal air passages
35 and the air cap cause a loss of air speed and a
36 reduction in air volume. The result of this is low

1 paint transfer rates, poor atomization and an inferior
2 paint finish. However, transfer efficiency is
3 improved. If the air volume is increased while keeping
4 the pressure low, the ratio of air to paint increases
5 and the problems experienced with high pressure will
6 return depending on the increase in volume.

7
8 Existing high pressure spray guns have been modified to
9 operate at low pressures, but the complexity of the
10 designs and the intricate interconnecting drilled
11 passages do not permit good air flow. In an effort to
12 overcome the poor performance, air cap ring gaps were
13 increased, resulting in a substantial increase in air
14 consumption. This type of spray gun has become known
15 as the high volume-low pressure (HVLP) gun.

16
17 More specifically, in HVLP spray guns the means for
18 actuating the control valves within the gun have had
19 considerable shortcomings. For example, it is
20 commonplace for the stem of the needle valve and its
21 associated compression spring and housing to extend
22 through the main air flow passage to the nozzle,
23 thereby leading to significant restrictions in the air
24 flow path.

25
26 Likewise, in order to provide a convenient means for
27 actuating the stem of the air flow and fluid needle
28 valves, the main nozzle of the apparatus is mounted on
29 a forward projection of the apparatus so as to leave a
30 free space to accommodate the arc of movement of the
31 valve control trigger.

32
33 Moreover, since the same trigger operates both the
34 liquid and air control valves, the progressive control
35 from on to off operating characteristics of the air
36 control valve can be restricted in certain operating

1 conditions where the liquid control valve has been
2 manually adjusted to such a point that it affects the
3 ability of the trigger to operate both valves
4 simultaneously through the full range of movement.

5

6 The object of the present invention is to provide a
7 method and apparatus for spraying paint and other
8 surface treatment liquids, offering improvements in
9 relation to one or more of the matters discussed above,
10 or generally.

11

12 According to a first aspect of the invention there is
13 provided an apparatus for spraying liquid surface
14 treatment material, said apparatus having a housing, a
15 liquid inlet for supply of the liquid surface treatment
16 material, a gas inlet for supply of pressurised gas to
17 be mixed with the liquid surface treatment material, an
18 outlet nozzle through which the gas and liquid surface
19 treatment material is sprayed, a control valve adapted
20 to regulate the supply of the liquid surface treatment
21 material to the outlet nozzle, a gas valve operable
22 between an open position and a closed position, a first
23 communicating passageway connecting said gas inlet to
24 said gas valve, and a second communicating passageway
25 connecting said gas valve to said outlet nozzle;
26 wherein said second passageway is provided with a
27 stepped portion therein so that a gas vortex is created
28 therethrough.

29

30 Preferably, said second passageway is offset from said
31 first passageway. Preferably, said second passageway
32 is substantially conical in shape. Preferably, said
33 second passageway includes an inlet and an outlet,
34 wherein said passageway is tapered from said inlet to
35 said outlet. Preferably, said taper is between 1 and
36 15°.

PROVISIONAL

1 Preferably, said stepped portion of said second
2 passageway comprises a ledge whose width tapers up to a
3 maximum of 10% of the radius of said second passageway
4 at the level of the stepped portion.

5

6 Preferably, said second passageway has a radius of
7 curvature at said outlet so as to provide gas to the
8 nozzle in a substantially horizontal direction.

9

10 Preferably, the longitudinal axis of said outlet nozzle
11 extends across said second passageway. Preferably, the
12 axis of symmetry of said ledge is offset from said
13 longitudinal axis of said outlet nozzle, thereby
14 inducing a vortex in the air flowing through said
15 passageway.

16

17 According to a second aspect of the invention there is
18 provided an apparatus for spraying liquid surface
19 treatment material, said apparatus having a housing, a
20 liquid inlet for supply of the liquid surface treatment
21 material, a gas inlet for supply of pressurised gas to
22 be mixed with the liquid surface treatment material, an
23 outlet nozzle through which the gas and liquid surface
24 treatment material is sprayed, a control valve adapted
25 to regulate the supply of the liquid surface treatment
26 material to the outlet nozzle, a gas valve operable
27 between an open position and a closed position, a first
28 communicating passageway connecting said gas inlet to
29 said gas valve, and a second communicating passageway
30 connecting said gas valve to said outlet nozzle;
31 wherein said second passageway is axially offset from
32 said first passageway and is substantially conical in
33 shape, and wherein said second passageway includes an
34 inlet and an outlet and is tapered from said inlet to
35 said outlet at an angle of taper of between 1 and 15°.
36

1 Preferably the apparatus further comprises a trigger
2 means, whereby said trigger means is adapted to operate
3 both of said control valve and said gas valve.

4
5 Preferably, said gas valve is an axially-sliding piston
6 valve. Preferably, said control valve is a liquid
7 control needle valve.

8
9 Preferably, said outlet nozzle is controlled by said
10 liquid control needle valve.

11
12 Preferably, said piston valve produces an annular air
13 jet in said second passageway. The piston valve may be
14 tapered or parallel. In addition, an air control valve
15 stem is provided which is connected to the piston valve
16 and operated by said trigger means.

17
18 Preferably, said piston valve comprises inner and outer
19 co-axial apertured sleeves, wherein said inner sleeve
20 is located within said outer sleeve and is rotatably
21 adjustable relative to said outer sleeve.

22
23 Preferably, the liquid control needle valve is
24 controlled by said trigger means via an axially-sliding
25 sleeve or slipper member situated on a rearward portion
26 of the housing. Preferably, it is also provided with a
27 rotational flow adjustment means to adjust the flow
28 rate of the liquid.

29
30 Preferably, said flow adjustment means comprises a stem
31 member, a rotational adjuster, and a return spring,
32 said stem member being threaded at its rearmost
33 extremity to accept the rotational adjuster.

34 Preferably, said stem member is actuated externally by
35 the trigger means, and is returned to its initial
36 position by a return spring.

1 Preferably, the apparatus further comprises a
2 regulating valve and a pair of side jets, whereby the
3 spray pattern of the outlet nozzle is regulated by said
4 regulating valve, and said side jets are utilised to
5 regulate said spray pattern.

6

7 Preferably, the needle valve is supplied with the paint
8 or material surface treatment liquid by a pressurized
9 material supply connector which distributes the
10 material via a radial port to said needle valve.

11 Alternatively, the material may be introduced to the
12 apparatus from a gravity liquid reservoir fitted to the
13 uppermost aspect of the apparatus via a radial port.

14

15 According to a third aspect of the present invention,
16 there is provided a method of spraying a fluid onto a
17 surface, said method comprising the steps of:

18 supplying a liquid to be sprayed into a liquid
19 inlet of a spray apparatus;

20 supplying a pressurised gaseous propellant into a
21 gas inlet of said spray apparatus;

22 passing said gaseous propellant through a
23 communicating passageway from said gas inlet to an
24 outlet nozzle;

25 accelerating said gaseous propellant by creating a
26 gas vortex as said propellant passes through said
27 communicating passageway;

28 passing said accelerated propellant through an
29 outwardly tapering portion of the communicating
30 passageway to further accelerate the vortex and supply
31 the propellant to the outlet nozzle in the form of an
32 annular gas jet; and

33 spraying said liquid onto a surface by mixing said
34 liquid and said annular gas jet at said nozzle.

35

36 Preferably, said passageway comprises an upper portion

1 and a lower portion, wherein said upper portion is
2 axially offset from said lower portion and is
3 substantially conical in shape. Preferably, said upper
4 portion of said passageway includes an inlet and an
5 outlet and is tapered from said inlet to said outlet at
6 an angle of taper of between 1 and 15°.

7

8 Preferably, the mixing of said liquid and said annular
9 gas jet is controlled by a trigger valve mechanism on
10 said spray apparatus. Preferably, said trigger valve
11 mechanism comprises:

12 a gas valve operable between an open position and
13 a closed position;

14 a control valve adapted to regulate the supply of
15 the liquid to be sprayed; and

16 a trigger means;

17 whereby said trigger means is adapted to operate
18 both of said gas and control valves.

19

20 Preferably, said control valve is a liquid control
21 needle valve. Preferably, said gas valve is an
22 axially-sliding piston valve. Preferably said piston
23 valve comprises an inner apertured sleeve and an outer
24 apertured sleeve, said inner and outer sleeves being
25 co-axial, and wherein said inner sleeve is located
26 within said outer sleeve and is rotatably adjustable
27 relative to said outer sleeve.

28

29 Embodiments of the invention will now be described by
30 way of example with reference to the accompanying
31 drawings in which :-

32

33 Figure 1 shows a first embodiment of a spray gun
34 according to the present invention;

35

36 Figure 2 shows a section through the spray gun of

1 Figure 1 having pressure feed and offset air passages;

2

3 Figure 3 shows a second embodiment of a spray gun

4 according to the present invention;

5

6 Figure 4(a) shows a section through the spray gun of

7 Figure 3 having offset air passages and a tapered upper

8 air passage;

9

10 Figure 4(b) is a sectional view along line "A-A" of

11 Figure 4(a);

12

13 Figure 4(c) is a sectional view along line "B-B" of

14 Figure 4(a), showing the stepped portion of the upper

15 air passage;

16

17 Figure 5 shows a third embodiment of a spray gun

18 according to the present invention;

19

20 Figure 6(a) shows a section through the spray gun of

21 Figure 5;

22

23 Figure 6(b) shows the component parts of the piston

24 valve of the spray gun of Figures 5 and 6(a); and

25

26 Figure 6(c) shows a sectional view along line "VI-VI"

27 of Figure 6(a).

28

29 As shown in Fig 1, a first embodiment of a spray

30 apparatus 10 comprises a body or housing 12 having a

31 nozzle 14, an operating trigger 40, and a regulating

32 valve 52. Nozzle 14 is secured to the housing 12 by a

33 threaded ring 11.

34

35 Figure 2 shows a section view through the spray gun

36 which shows the components of the apparatus 10 in more

1 46, thereby opening the needle valve 22 to allow liquid
2 to pass through.

3

4 A regulating valve 52 is positioned whereby the jet 15
5 produced by nozzle 14 is regulated from a natural cone
6 to a fan pattern by air from side jets 17.

7

8 The air passage 38 connects the air supply connection
9 16 with the piston valve 23. The air control valve
10 stem 20 controls the air flow through a pair of offset
11 passages 38 and 39, where the lower passage 38 and the
12 upper passage 39 are offset to create a vortex within
13 the upper passage 39, thereby accelerating the gas flow
14 through said upper passage 39. A return spring 25 is
15 also provided in order to return the piston 24 and stem
16 20 to their extended position when released. The
17 piston valve 23 has two apertured rotational sleeves 26
18 which can be adjusted by a lever 21 to either line up,
19 close off or partially close the apertures, thereby
20 increasing or decreasing the vortex in the passage 39.
21 Thus, the pressure in the gun can be regulated to offer
22 variable pressure sprays. A more detailed description
23 of the operation of the piston valve 23 is given later.

24

25 The liquid control valve needle 22 has a stem member 42
26 which passes through sleeve member 46 and is threaded
27 at its rearmost extremity to accept the rotational
28 adjuster 44. The rotational adjuster 44 allows fine
29 position adjustment of the fluid control needle 22.
30 Trigger 40 actuates the needle member 22 externally of
31 the housing 12. An internal return spring (not shown)
32 returns the needle 22 to its rest position. Liquid to
33 be sprayed is fed to the needle valve 22 from
34 connection 18 via a radial port 56.

35

36 Figure 3 shows a second embodiment of a spray gun

1 Thus, the vortex flows through the chamber 51
2 relatively unhindered by the valve 22 as the gas flows
3 around the outside of the valve 22, and the vortex is
4 not destroyed by the valve 22.

5

6 Aside from the amendments to the passage 39, this
7 embodiment of the spray gun 10 is constructed and
8 operated substantially in the same manner as the spray
9 gun 10 of figure 1.

10

11 The third and final of the preferred embodiments
12 described is shown in Figures 5 and 6(a)-(c). Again,
13 externally, the spray gun 10 is similar in appearance
14 to the other embodiments, with the majority of the
15 components previously described above being used.
16 However, the third embodiment differs in the operation
17 of the piston valve assembly 23 which produces the
18 vortex.

19

20 The use of a pair of apertured sleeves 26a,26b within
21 the piston valve assembly 23 was first discussed in the
22 description of the first embodiment above. However,
23 the individual components of the piston valve assembly
24 23 are best seen in Figure 6(b). The valve assembly 23
25 consists of an apertured outer sleeve 26b and an
26 apertured inner sleeve 26a, and each of the sleeves
27 26a,26b has a pair of apertures 61,62. On each sleeve
28 26a,26b, the apertures 61,62 are located diametrically
29 opposite one another, thereby permitting gas to pass
30 through the sleeves 26a,26b unhindered.

31

32 Figure 6(a) shows the manner in which the various
33 components of the valve assembly 23 co-operate. The
34 inner sleeve 26a is located inside the outer sleeve
35 26b, with the apertures 61,62 of the two sleeves
36 26a,26b being axially aligned to allow gas to pass

1 upper passage 39 of the apparatus 10.

2

3 In use, each of the embodiments is operated as follows:
4 The reservoir of material to be sprayed delivers the
5 material to central jet 15 under the control of needle
6 valve 22 where it is mixed with air delivered via air
7 passages 38 and 39. The operation of the gun is
8 initiated by trigger 40 operating air control valve
9 stem 20 and liquid control valve 22.

10

11 The present invention provides a method and apparatus
12 for spraying that addresses the limitations and
13 inefficiencies of prior spray guns. As it may operate
14 at pressures as low as 1.5psi in the air cap and at air
15 volumes as low as 4cfm, energy savings are achieved.
16 The very low pressures allow a very high transfer
17 efficiency to be achieved which is an added advantage
18 when used with paints containing volatile organic
19 compounds.

20

21 The present invention permits the trigger 40 to operate
22 the air control valve 23 and the fluid control valve 22
23 simultaneously, without restricting the operation of
24 either, regardless of the adjustment of the other. The
25 stems of both the fluid control needle valve 22 and air
26 control piston valve 23 operate in parallel to each
27 other, yet independently of each other.

28

29 The above permits a straight, unobstructed, large
30 diameter air passage 38 to the air valve 23 while also
31 permitting a short, straight air passage 39 to the air
32 cap 52 and a large diameter fluid passage.

33

34 In addition, by offsetting the air passages 38,39, gas
35 acceleration may be achieved by means of a vortex
36 created by the gas passing through these passages

1 Air volume required is approximately 50% lower than the
2 average of the representative selection.

3

4 Depression at the fluid nozzle is approximately 30%
5 greater than the representative selection.

6

These and other improvements and modifications can be incorporated without departing from the scope of the invention.

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1 CLAIMS:

2

3 1. An apparatus for spraying liquid surface treatment
4 material, said apparatus comprising:

5

a housing;

6

a liquid inlet for supply of the liquid surface
7 treatment material;

8

9 a gas inlet for supply of pressurised gas to be
mixed with the liquid surface treatment material;

10

11 an outlet nozzle through which the gas and liquid
surface treatment material is sprayed;

12

13 a control valve adapted to regulate the supply of
the liquid surface treatment material to the outlet
14 nozzle;

15

16 a gas valve operable between an open position and
a closed position;

17

18 a first communicating passageway connecting said
gas inlet to said gas valve; and

19

20 a second communicating passageway connecting said
gas valve to said outlet nozzle;

21

22 wherein said second passageway is provided with a
stepped portion therein so that a gas vortex is created
23 therethrough.

24

25 2. An apparatus according to Claim 1, wherein said
26 second passageway is offset from said first passageway.

27

28 3. An apparatus according to either Claim 1 or Claim
29 2, wherein said second passageway is substantially
30 conical in shape.

31

32 4. An apparatus according to any preceding claim,
33 wherein said second passageway includes an inlet and an
34 outlet, wherein said second passageway is tapered from
35 said inlet to said outlet.

36

1 5. An apparatus according to Claim 4, wherein said
2 taper is between 1 to 15°.

3

4 6. An apparatus according to either Claim 4 or Claim
5 5, wherein said second passageway has a radius of
6 curvature at said outlet so as to provide gas to the
7 outlet nozzle in a substantially horizontal direction.

8

9 7. An apparatus according to any preceding claim,
10 wherein said stepped portion of said second passageway
11 comprises a ledge whose width tapers up to a maximum of
12 10% of the radius of said second passageway at the
13 level of the stepped portion.

14

15 8. An apparatus according to Claim 7, wherein the
16 longitudinal axis of said outlet nozzle extends across
17 said second passageway.

18

19 9. An apparatus according to Claim 8, wherein the
20 axis of symmetry of said ledge is offset from said
21 longitudinal axis of said outlet nozzle.

22

23 10. An apparatus for spraying liquid surface treatment
24 material, said apparatus comprising:

25 a housing;

26 a liquid inlet for supply of the liquid surface
27 treatment material;

28 a gas inlet for supply of pressurised gas to be
29 mixed with the liquid surface treatment material;

30 an outlet nozzle through which the gas and liquid
31 surface treatment material is sprayed;

32 a control valve adapted to regulate the supply of
33 the liquid surface treatment material to the outlet
34 nozzle;

35 a gas valve operable between an open position and
36 a closed position;

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20

1 a first communicating passageway connecting said
2 gas inlet to said gas valve; and
3 a second communicating passageway connecting said
4 gas valve to said outlet nozzle;
5 wherein said second passageway is axially offset
6 from said first passageway and is substantially conical
7 in shape, and wherein said second passageway includes
8 an inlet and an outlet and outwardly tapers from said
9 inlet to said outlet at an angle of taper of between 1
10 and 15°.

11
12 11. An apparatus according to any preceding claim,
13 further comprising a trigger means;
14 whereby said trigger means is adapted to operate
15 both of said control valve and said gas valve.

16
17 12. An apparatus according to Claim 11, wherein said
18 control valve is a liquid control needle valve.
19

20
21 13. An apparatus according to Claim 12, wherein said
22 gas valve is an axially-sliding piston valve.

23
24 14. An apparatus according to Claim 13, wherein said
25 outlet nozzle is controlled by said liquid control
needle valve.

26
27 15. An apparatus according to either Claim 13 or Claim
28 14, wherein said piston valve produces an annular air
29 jet in said second passageway.
30

31
32 16. An apparatus according to any of Claims 13 to 15,
33 further comprising an air control valve stem which is
34 connected to said piston valve and operated by said
trigger means.
35

36 17. An apparatus according to any of Claims 13 to 16,

1 wherein said piston valve comprises an inner apertured
2 sleeve and an outer apertured sleeve, said inner and
3 outer sleeves being co-axial, and wherein said inner
4 sleeve is located within said outer sleeve and is
5 rotatably adjustable relative to said outer sleeve.

6

7 18. An apparatus according to any of Claims 12 to 17,
8 wherein the liquid control needle valve is controlled
9 by said trigger means via an axially-sliding sleeve or
10 slipper member situated on a rearward portion of said
11 housing.

12

13 19. An apparatus according to any of Claims 12 to 18,
14 wherein said liquid control needle valve is provided
15 with a rotational flow adjustment means.

16

17 20. An apparatus according to Claim 19, wherein said
18 flow adjustment means comprises a stem member, a
19 rotational adjuster, and a return spring, said stem
20 member being threaded at its rearmost extremity to
21 accept said rotational adjuster.

22

23 21. An apparatus according to Claim 20, wherein said
24 stem member is actuated externally by said trigger
25 means, and is returned to its initial position by said
26 return spring.

27

28 22. An apparatus according to any of Claims 12 to 21,
29 wherein said liquid inlet comprises a pressurized
30 material supply connector, and wherein said needle
31 valve is supplied with a liquid by said pressurized
32 material supply connector.

33

34 23. An apparatus according to any of Claims 12 to 21,
35 wherein said liquid inlet comprises a gravity feed
36 liquid reservoir, and wherein said needle valve is

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1 portion of said passageway includes an inlet and an
2 outlet and is tapered from said inlet to said outlet at
3 an angle of taper of between 1 and 15°.

4

5 28. A method according to any of Claims 25 to 27,
6 wherein the mixing of said liquid and said annular gas
7 jet is controlled by a trigger valve mechanism on said
8 spray apparatus.

9

10 29. A method according to Claim 28, wherein said
11 trigger valve mechanism comprises:

12 a gas valve operable between an open position and
13 a closed position;

14 a control valve adapted to regulate the supply of
15 the liquid to be sprayed; and

16 a trigger means;

17 whereby said trigger means is adapted to operate
18 both of said gas and control valves.

19

20 30. A method according to Claim 29, wherein said
21 control valve is a liquid control needle valve.

22

23 31. A method according to Claim 30, wherein said gas
24 valve is an axially-sliding piston valve.

25

26 32. A method according to Claim 31, wherein said
27 piston valve comprises an inner apertured sleeve and an
28 outer apertured sleeve, said inner and outer sleeves
29 being co-axial, and wherein said inner sleeve is
30 located within said outer sleeve and is rotatably
31 adjustable relative to said outer sleeve.

32

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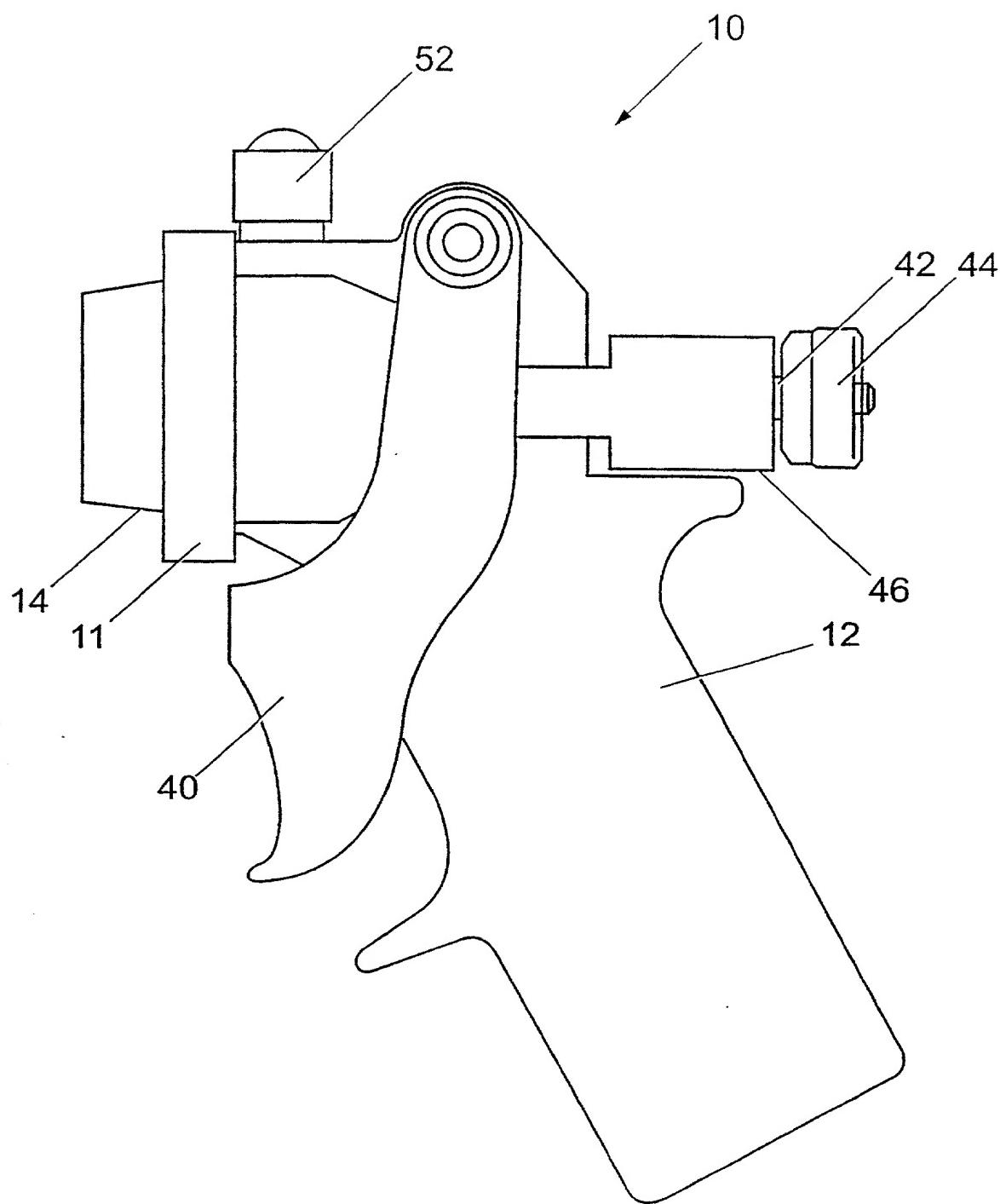


Fig. 1

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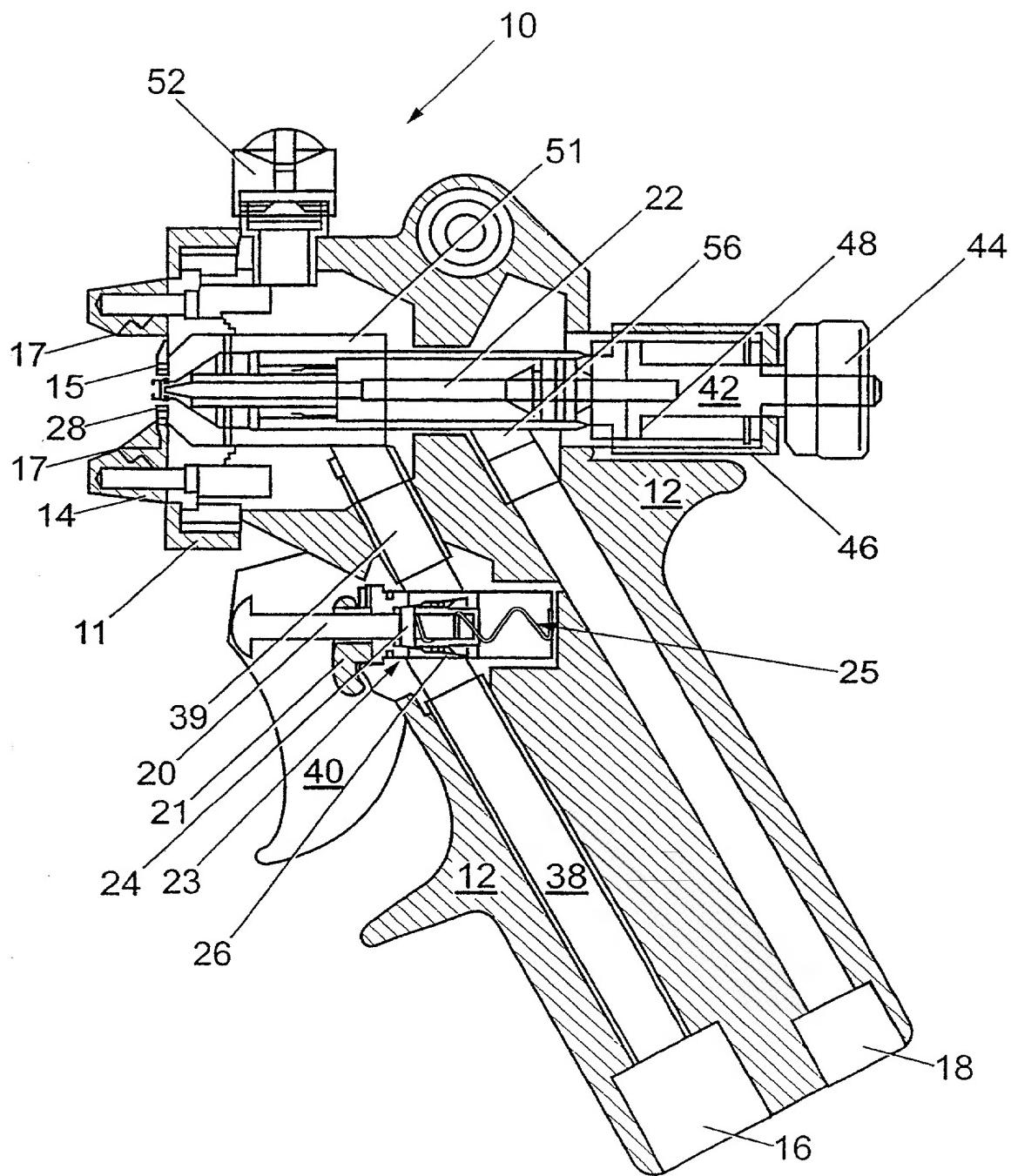


Fig. 2

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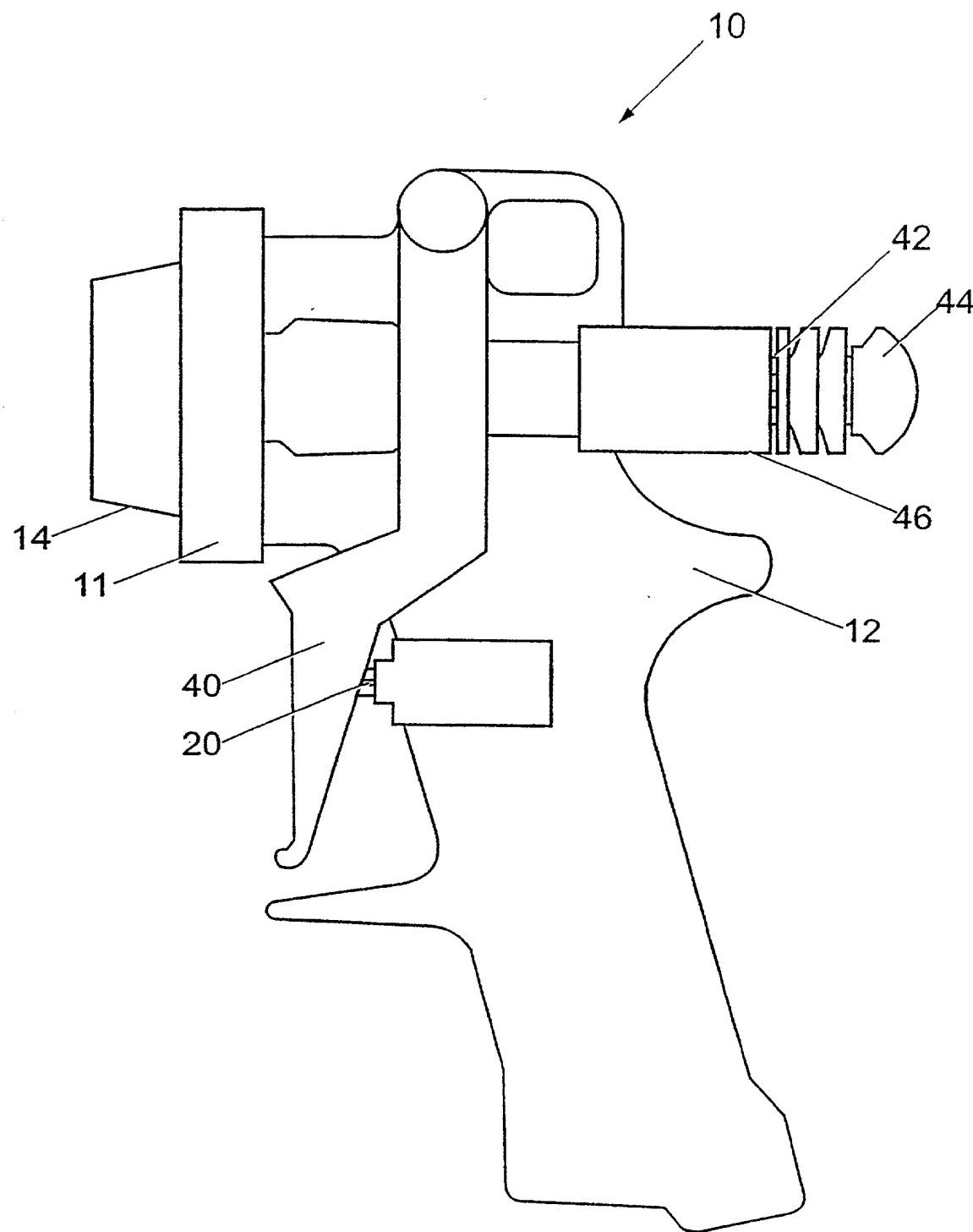


Fig. 3

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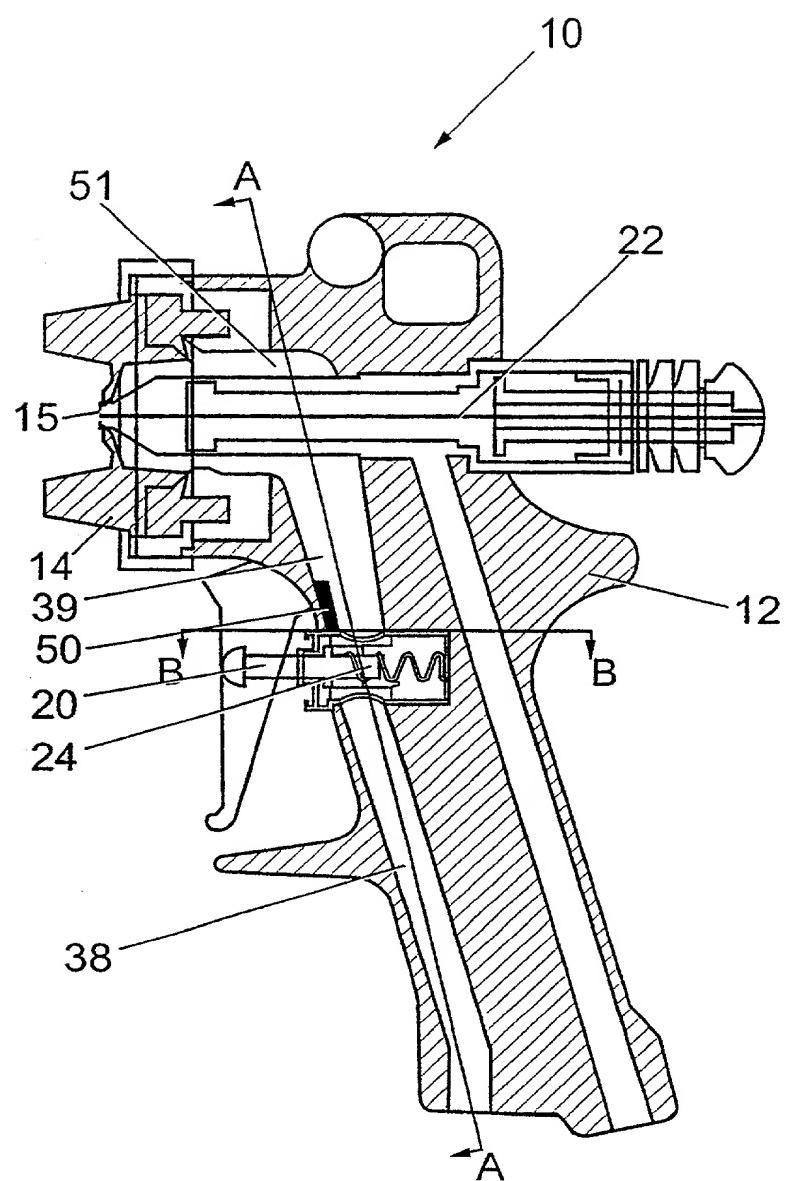


Fig. 4a

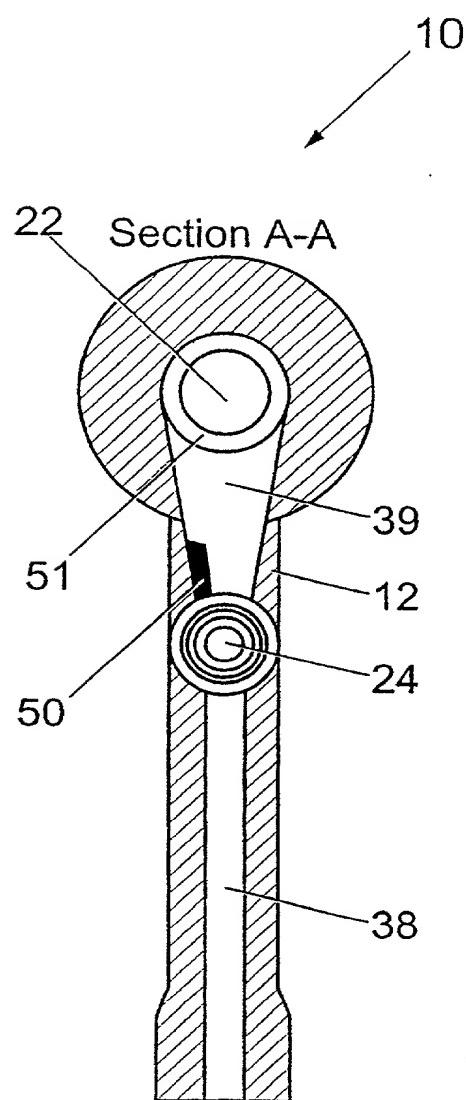


Fig. 4b

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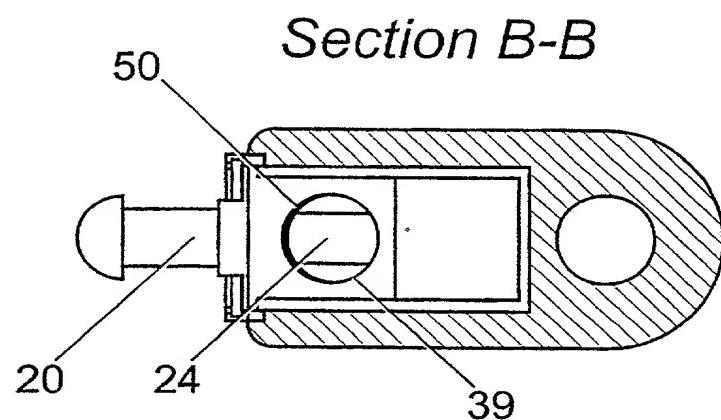


Fig. 4c

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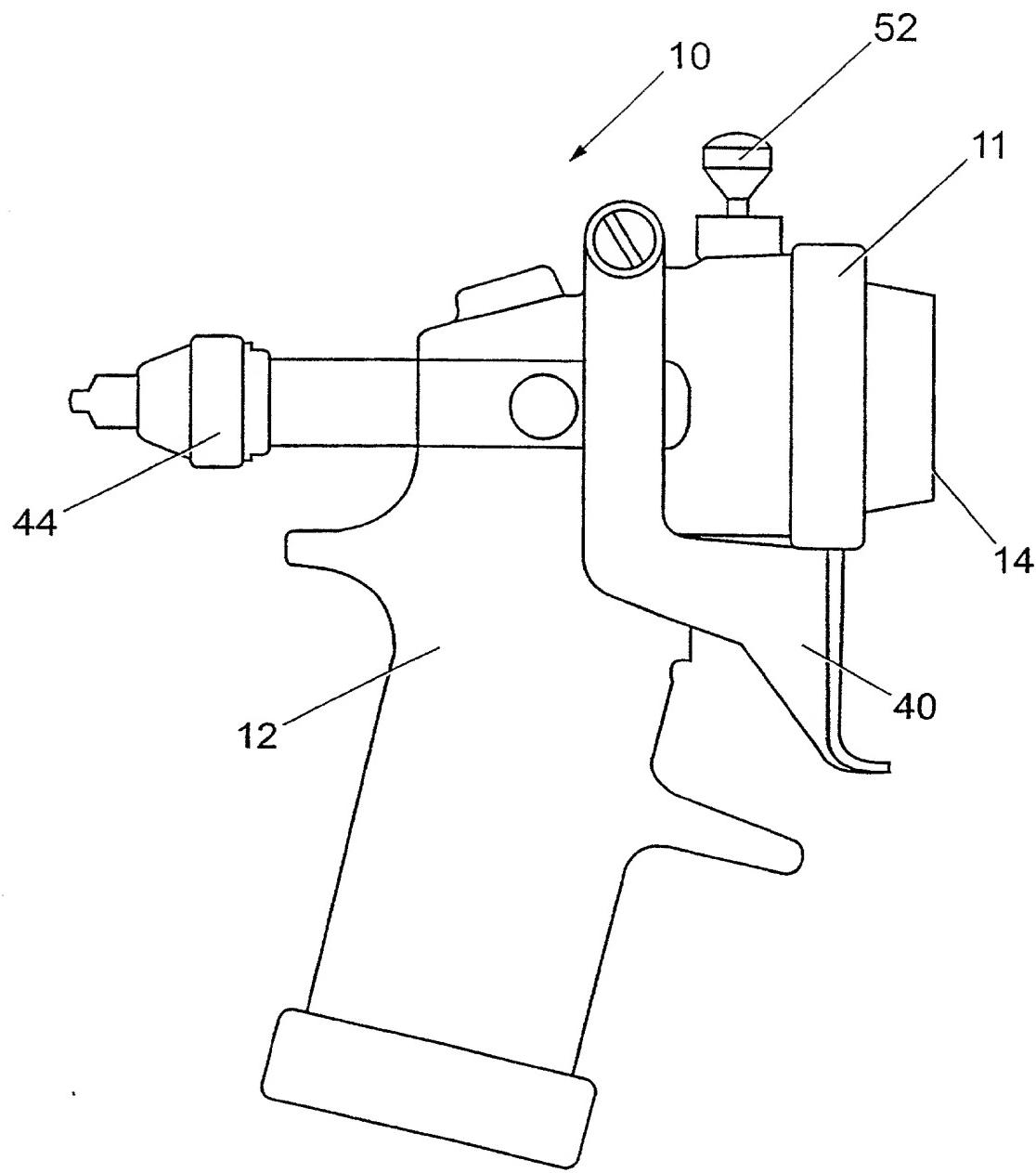


Fig. 5

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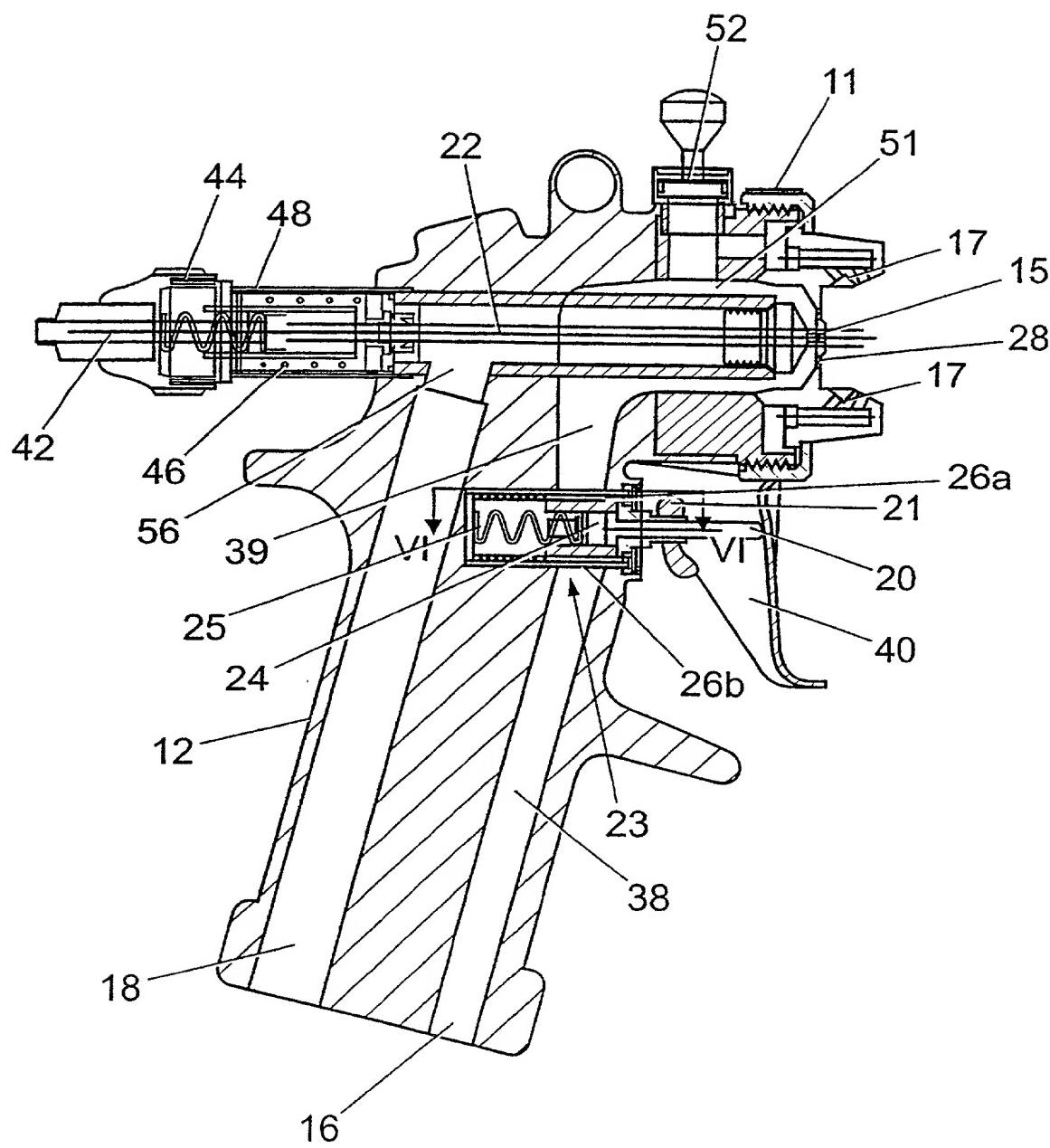


Fig. 6a

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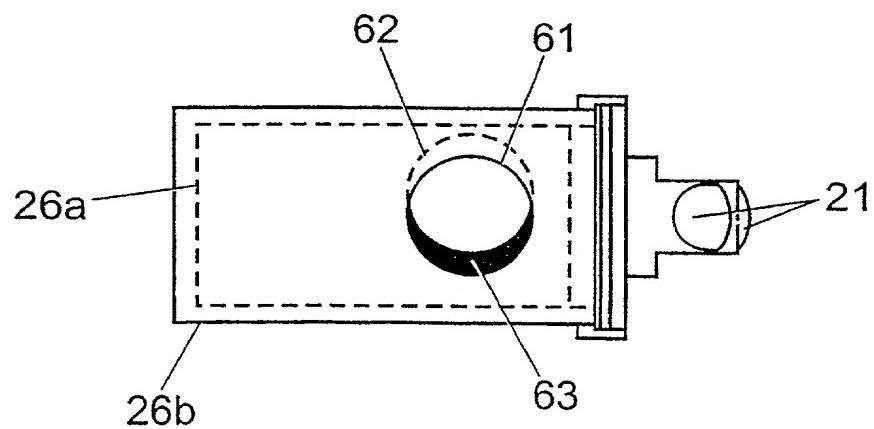
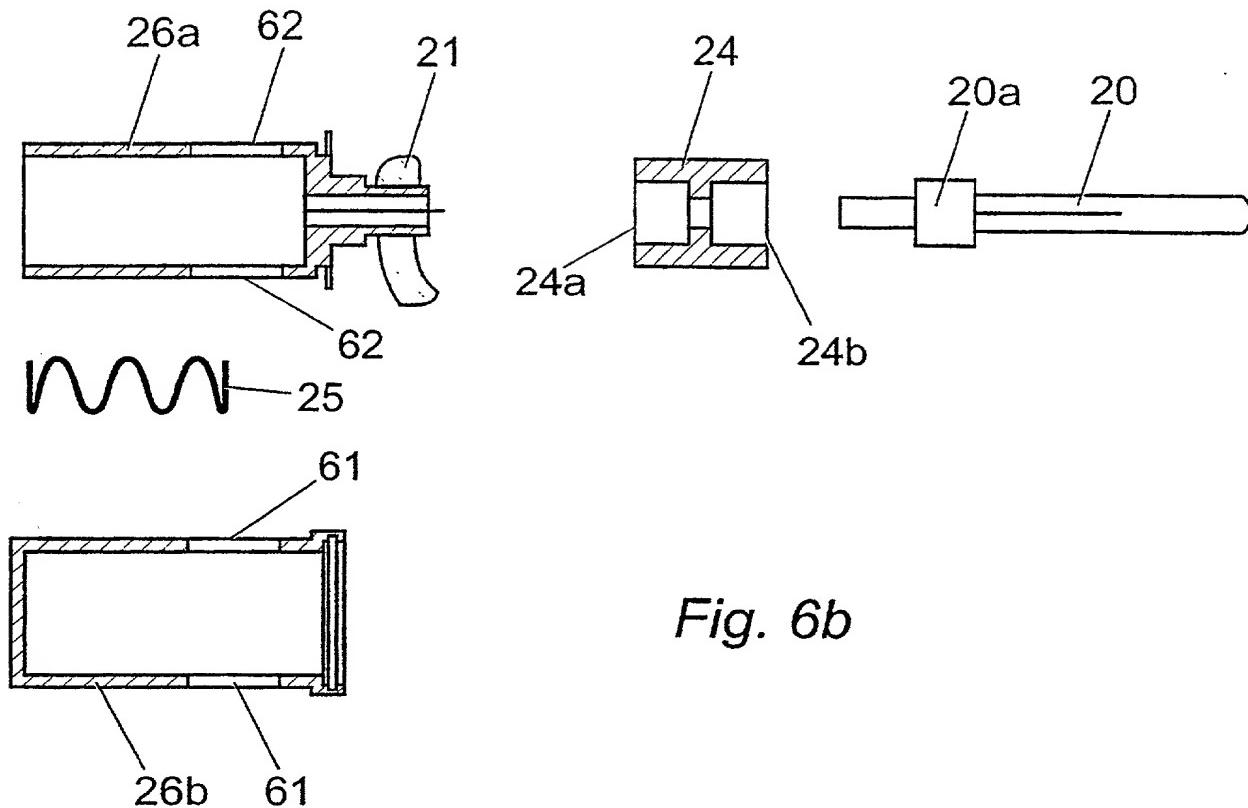


Fig. 6c



PATENT
Attorney Docket No. 36290-151384

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are stated below next to my name:

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD AND APPARATUS FOR SPRAYING

the specification of which is attached hereto unless the following box is checked

was filed on October 20, 1999 as Application No. _____ or
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I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with 37 CFR §1.56.

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PRIOR FOREIGN/PCT APPLICATION(S)

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GB	9823032.9	October 22, 1998	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO

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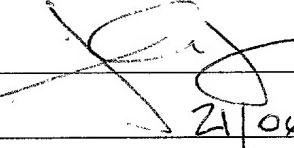
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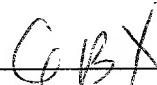
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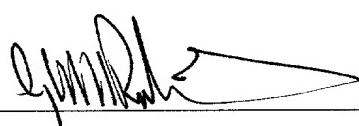
(GIVEN NAME)

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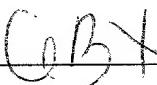
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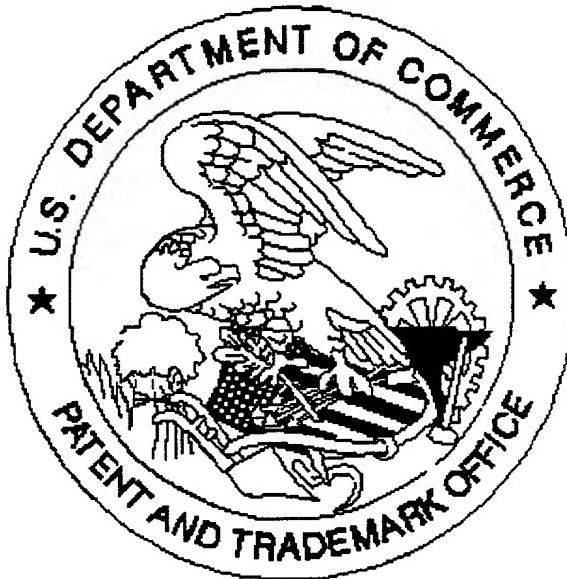
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